School food policies and practices in nine European countries: The Pro Children Project

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Foreword

This master thesis follows the proposed delivery format of a scientific article (Appendix 1) with additional expanded sections on background (chapter 1), methods (chapter 2) and discussion (chapter 4). The draft scientific article should be considered the main component of the thesis. Due to the nature of the dataset, which ideally requires multilevel data analysis, the article will require some further work before it will be submitted to a peer-reviewed journal for publication.

An abstract of the thesis is provided at the beginning of the article in Appendix 1.

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1. Introduction

1.1 Fruit and vegetable intake and overweight in children

The protective effect of an adequate intake of fruits and vegetables on the development of noncommunicable diseases (NCDs) such as cardiovascular diseases and certain forms of cancers is well established (WHO 2003, WCRF 2007). According to the latest World Health Organization *Global Health Risks* report (WHO 2009a), a low fruit and vegetable intake ranks as the 8th and 7th leading risk factor for premature death in middle and high-income countries, respectively. Globally, insufficient fruit and vegetable intake is estimated to cause around 14% of gastrointestinal cancer deaths, about 11% of ischemic heart disease deaths and about 9% of stroke deaths (WHO 2009a).

Studies show that eating according to dietary recommendations during childhood positively influences healthy eating habits in adults and thereby may be protective against diseases in adulthood (Knai *et al*. 2006). However, children in most parts of the world are not meeting the consumption goals of 400 g/day as suggested by the WHO/Food and Agricultural Organization of the United Nations (FAO) Expert Consultation on Diet, nutrition and the prevention of chronic diseases (WHO 2003). Results from the 2005/2006 Health Behaviour in School-Aged Children (HBSC) study showed that the proportion of 11-year olds in countries in the WHO European Region who ate at least one fruit daily was low and varied considerably between the countries (WHO 2008a). For boys the proportion ranged between 48% in Portugal and 18% in Greenland and for girls it ranged between 57% in Norway and 20% in Greenland. Furthermore, the same study showed that consumption is lower among children from low-income families in almost all countries. Results from the European Pro Children Project showed that fruit and vegetable intake in 11-year-old children

was far below population goals, averaging 250 grams per day in total across the countries (Velde *et al*. 2008).

While the benefits of an adequate fruit and vegetable intake among children are clear, it should be mentioned that a recent review (Newby 2009) concludes that there is not sufficient evidence to date to say that fruit and vegetable consumption has a protective effect on the risk of developing obesity in childhood, yet, opinions about this are divided (Briefel *et al*. 2009).

Overweight and obesity, usually measured by Body Mass Index (BMI)[1], is another major public health challenge. WHO estimates that in 2005, more than 1 billion adults were overweight and an additional 300 million were obese, and about 22 million children under the age of 5 were overweight (WHO 2005). Current estimates show that globally, 44% of the diabetes burden, 23% of ischemic heart disease burden and between 7 and 41% of certain cancer burdens are attributable to overweight and obesity (WHO 2009a). Overweight and obesity is the 3rd leading risk factor for premature death in both high and middle-income countries, after high blood pressure and tobacco use, and the rates are projected to increase in almost all countries (WHO 2009a).

Up to one third of the children in the WHO European Region are currently affected by overweight[2] or obesity. Results from the HBSC study in 2005/06 showed that in this region the prevalence of overweight among 11-year-old boys ranged from 30% in Malta to 5% in the Netherlands and among girls it ranged from 25% in Malta to 5% in Switzerland (WHO 2008a). Again, children from low-income families are disadvantaged, consistently showing higher levels of overweight. The Pro Children Project found that the overall proportion of overweight 11-year olds in the nine participating countries was around 11% among girls and 16% among boys but varied

[1] BMI is calculated as the weight in kilograms (kg) divided by height in meters squared (m^2): (kg/m^2).

[2] Henceforth, the term "overweight" also includes obesity, unless otherwise stated.

greatly with proportions of overweight boys as high as 26% in Portugal and girls as low as 6% in the Netherlands (Yngve *et al*. 2008).

Overweight during childhood and adolescence is associated with an increased risk of adult obesity and NCDs such as cardiovascular diseases, diabetes and cancer, as well as a number of immediate health-related problems, including social and psychological problems (Dietz 1998, WHO 2007, WHO 2008a). The magnitude of the problem and increased awareness of the related health and financial implications have spurred research on prevention of childhood obesity but also global calls for political action to tackle the problem (WHO 2004; 2008b).

The public health challenges seem clear, but the evidence of what works to increase children's fruit and vegetable consumption and prevent overweight is only gradually building up. The evidence base is stronger for interventions to promote fruit and vegetable consumption among children (Knai *et al*. 2006, Sa & Lock 2008) than on the best strategies to prevent childhood obesity (Summerbell *et al*. 2005, Doak *et al*. 2006, WHO 2009b). A recent review of school-based fruit and vegetable intervention programmes in Europe found that 70% of the studies showed increased fruit and vegetable intake at follow-up and that they also increased children's knowledge (Sa & Lock 2008).

For obesity prevention, results of cost-effectiveness projections such as the Assessing Cost-Effectiveness in Obesity (ACE-Obesity) project (Haby *et al*. 2006), indicate that upstream policy interventions, such as regulations to reduce food and drink advertising to children, would have the greatest impact, but many school-based intervention studies have shown promising results, especially interventions taking a multi-component approach (Lissau 2006, Sa & Lock 2008; WHO 2009b). The WHO summary report of a systematic review of the evidence of effectiveness of diet and physical activity interventions to prevent NCDs (up to June 2006) - *Interventions on diet and physical activity: What Works* (WHO 2009b) summaries the evidence on

school-based interventions as follows:

> School-based interventions show consistent improvements in knowledge and attitudes, behaviour and, when tested, physical and clinical outcomes. There is strong evidence to show that schools should include a diet and physical activity component in the curriculum taught by trained teachers; ensure parental involvement; provide a supportive environment; include a food service with healthy choices; and offer a physical activity programme. However there is lack of cost-effectiveness research in this area.

The review identified positive changes in physical and clinical outcomes in 15 interventions and no effects in six interventions. However, among the 10 primarily diet-based interventions, only one study qualified as a highest ranking study and thus labelled "effective", defined as having a robust experimental design or sufficient sample size and generating significant effects on specified outcome variables and this one study ("Know Your Body") was a multi-component 6-year intervention.

1.2 Theoretical Framework

A range of factors at multiple levels together influence children's health behaviours. A theoretical framework which illustrates many of the factors that influence children's food intake and BMI is suggested in Figure 1 below. Factors that will be discussed in this thesis are marked in grey. By considering a number of influences beyond the individual, this framework fits within the social ecological perspectives increasingly favoured in understanding health behaviours.

The framework suggests that socioeconomic status (SES) is an important factor in children's environment, with links both to the family and the school. Due to the clear socioeconomic gradient in obesity prevalence it has been suggested that SES is a structural influence on childhood obesity (Lobstein, Baur & Uauy 2004, Sacks, Swinburn & Lawrence 2008). SES is therefore placed within the environmental

variables in the figure and not the individual. It is, however, challenging to place SES as a separate factor in any one place and SES may instead be seen as an underlying factor influencing many of the aspects shown in the figure. Whereas not all the policy variables in the figure will be discussed, they should be seen as underlying determinants of health for societies (Sacks, Swinburn & Lawrence 2009), of which many may directly or indirectly influence food-related policies and practices at school level.

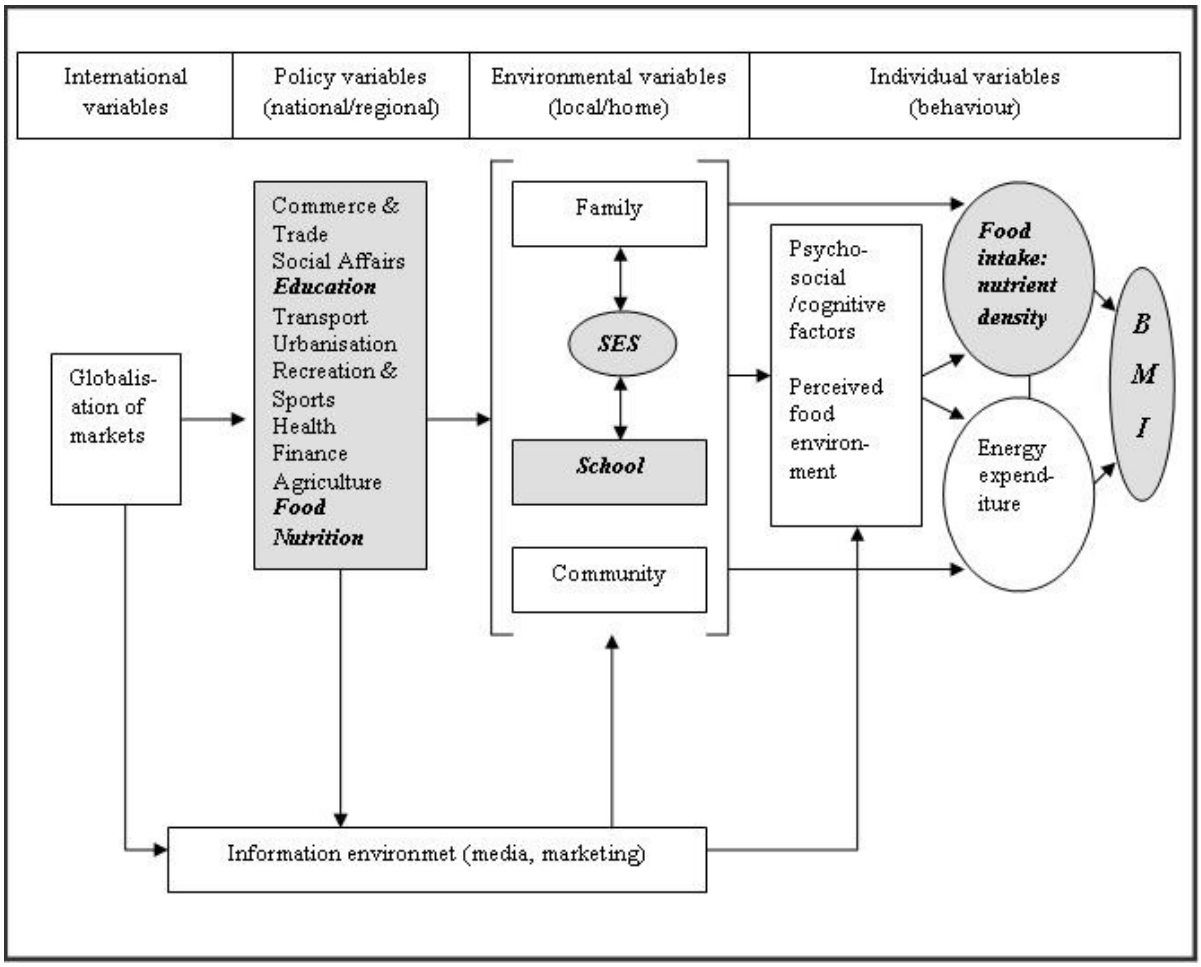


Figure 1 Policies and processes influencing children's food intake and weight, adapted from Kumanyika *et al*. 2002 and Glanz *et al*. 2005.

1.3 The school as setting for health promotion

The school is a favoured setting for interventions aiming to improve children's health behaviour (WHO 2009b). Fruit and vegetable promotion and obesity prevention are no exceptions to that. The rationale is rather straight forward: the school constitutes a place where children spend a significant amount of their time and consume a considerable amount of their daily food intake (Briefel *et al*. 2009, Jaime & Lock 2009). The school can at the same time influence personal, social and physical determinants of children's eating behaviour and is generally the only arena where children from all socioeconomic and cultural backgrounds meet the same norms and practices (French & Stables 2003, Klepp *et al*. 2005). Furthermore, schools may be an arena with less resistance to interventions and research as compared to other arenas (Gittelsohn & Kumar 2007) and schools also have the opportunity to reach beyond children themselves, to their families and wider community (WHO 2006a). However, due to the challenges linked to sustainability of school-based programmes and long-term intervention effects, community-based change strategies, in which schools would only be one entry point for change among a number of others, have increasingly been called for (Kubik, Lytle & Story 2005b, Gittelsohn & Kumar 2007).

1.4 The school food environment

For some time school-based intervention studies that aimed to improve children's health behaviour focused on cognitive aspects of children's behaviour and therefore leaned heavily on educational components. Increasingly, aspects of the physical eating environment are subject to research and particularly factors linked to the availability of healthy and unhealthy food in the school environment, such as school meal provision. However, there is a growing research interest in looking even beyond those factors, to including all potential factors that may directly or indirectly influence eating in school. One strain of research is as asking whether the existence of a school food policy can predict a more healthy physical and social food environment at

school, which in turn may predict healthier eating behaviour and weight status among schoolchildren.

Studies of this kind are often referring to the "school food environment" (Jaime & Lock 2009). This term can be interpreted in different ways (McKinnon *et al*. 2009) and there is no consistency yet in the way it is being used in the literature. According to Lytle (2009), the "school food environment" affects children's health directly through the physical and social environment or indirectly by providing the context in which important health-related decisions are made. Demarcation between the physical and social environment may be difficult however and Lytle (2009) has pointed out that research into the social environment and how it affects food and eating is limited.

Others prefer to use the term "school food environment and practices" to cover all aspects (e.g. Briefel *et al*. 2009; Fox *et al*. 2009), or "school food environment and policies" (Finkelstein, Hill & Whitaker 2008), implying that the term "school food environment" does not cover everything. Similarly, there seems to be no overall agreement on what "policy" refers to. Some researchers haven chosen to exclusively study school food policies that are codified and enforceable (Sacks, Swinburn & Lawrence 2008) whereas others use "policy" broadly to incorporate nutrition guidelines, regulations on availability of products in a school setting and price interventions, even if only in an intervention setting (Jaime & Lock 2009).

A relevant reference when discussing the school food environment is the *School Policy Framework* published by WHO in 2008. In the WHO *Global Strategy on Diet, Physical Activity and Health*, agreed by all WHO Members States in 2004, governments were encouraged to "adopt policies that support healthy diets at school and limit the availability of products high in salt, sugar and fats" (WHO 2004). The *School Policy Framework* (WHO 2008c) was developed as a tool to guide policy-makers at national and sub-national levels in the development and implementation of policies that promote healthy eating and physical activity in the school setting. The recommended policy options for countries relate to the following core areas:

- the development of school recognition programmes which award schools if they meet a number of predetermined criteria (such as WHO's Nutrition-Friendly Schools Initiative or Health Promoting Schools);
- the school curriculum;
- the food service environment (nutrition standards for school food, school food programme, food service area, vending machines and snack bars, food and non-alcoholic beverage marketing, food availability near school);
- the physical environment
- health promotion for school staff (they need to be aware of and responsible for the messages they give as role models to schoolchildren and others); and
- the school health services

The list illustrates many aspects of the school environment that may affect children's health behaviour and therefore need to be addressed in a school policy. Furthermore, there is reason to believe that some of these factors could reinforce each other and that the absence of some could undermine efforts in another area. An example of the latter would be a school having on the curricula to teach children about healthy eating while offering plenty of unhealthy options in the school canteen (French, Story & Fulkerson 2002). As pointed out by Carter and Swinburn (2004), health education takes place both inside and outside the classroom, i.e. the context in which children learn about healthy eating in school determines how receptive they are to the nutrition messages.

1.5 School food policies and practices – available evidence

A recent systematic review (Jaime & Lock 2009) shows that the current evidence on effectiveness of school food and nutrition polices is limited. The review did not identify any studies that evaluated cost-effectiveness. However, of the 18 included

studies, most evidence was identified for an impact of nutrition guidelines on (i) decreasing fat and increasing fruit and vegetable availability in school food provision and (ii) improving children's dietary intake. The evidence for effects of regulation of food and beverage availability was limited but also inconsistent. Whereas two studies indicated a decrease in the sale of unhealthy foods after restrictions, one of the studies (Cullen *et al*. 2006) also showed that the intervention had unintended negative consequences because children seemed to compensate for the lack of access to the banned foods by buying other popular processed foods. Also several price intervention studies have shown an effect, e.g. that free or subsidised fruit and vegetable subscription programmes have increased children's consumption (e.g. Bere *et al*. 2007). The review (Jaime & Lock 2009) identified only one study (Sahota *et al*. 2001) that had evaluated impact of school food and nutrition policies on BMI (but found no significant effect).

Several other studies not identified by the above described review have also shown that policies or programmes to change menu composition, food availability and children's intake have had the desired effect, such as an increased intake of fruit and vegetables after improvements in availability (e.g. Kubik *et al*. 2003), however, as also pointed out by Krølner *et al*. (2009), the available evidence today is insufficient to draw any conclusions about school level impact on fruit and vegetable intake.

Although some studies show that school food policies can improve the school food environment, several researchers have pointed out that it is not clear which components of them have the greatest potential to affect dietary behaviour or weight (Briefel *et al*. 2009, Fox *et al*. 2009, Jaime & Lock 2009). For example, a recent multi-component school policy intervention of two year duration (not included in the systematic review by Jaime & Lock) had a positive and substantial impact on children's BMI, but in addition to a nutrition policy component the intervention included self-assessment and development of an action plan for change, staff training, enhanced nutrition education, social marketing and meetings with parents (Foster *et al*. 2008). Since sustained interventions of this kind are not feasible at population

level, there is still a need to identify the most cost-effective school food policy options.

Despite weaknesses with cross-sectional study design that are not necessarily carried out after a food or nutrition policy has been implemented, several studies in that category show interesting findings worth noting. Fox *et al*. (2009) found that elementary school children who were offered French fries more than once per week were more likely to be obese than children in schools where French fries were never offered or only offered once per week. Briefel *et al*. (2009) found that children attending schools without stores or snack bars had a lower daily consumption of sugar-sweetened beverages. Kubik, Lytle & Story (2005a) found positive associations between selected school-wide food practices, such as the use of unhealthy foods in classroom fundraising and as rewards and incentives for children, and BMI.

1.6 Terminology and background for the present study

For the purpose of this thesis, the term "school food environment" was interpreted broadly and seen as comprising all of the factors listed in the WHO *School Policy Framework*. However, whereas many of these factors will be touched upon, the focus is on school food policies and practices. "School food policies" refer to written or un-written rules relating to food in school, e.g. rules for accessibility of healthy food, restrictions on availability of unhealthy food and curricular lessons on healthy eating or development of food preparation skills. "Practices" refer to aspects of both the physical and social environment, such as the availability of vending machines and teachers' use of food as rewards. This terminology is similar to that used by French, Story & Fulkerson (2002).

As illustrated in Figure 1, food policy and practices in any given school can be influenced by a variety of factors beyond the school itself, both at community and higher levels, such as the public education finance systems, food availability, marketing and cultural norms (Briefel *et al*. 2009). It is also difficult to identify the

relative importance of the school as a factor in influencing children's dietary behaviour and weight, since a long list of factors beyond the school setting are likely to also be important.

Despite these limitations, it is possible to hypothesize that there is a link between headmaster awareness of national or regional policies and the existence of a school food policy and between having a policy at school and following "healthful" school food practices. Furthermore, it may be hypothesized that that there could be a link between having a school food policy and following healthful practices and health-related outcomes among children at those schools, such as their fruit and vegetable intake and weight.

Composite scores are often used in assessing how schools rank on evidence of health-promoting food policies and practices (e.g. Finkelstein, Hill & Whitaker 2008) or in terms of number of unhealthy food practices allowed (e.g. Kubik, Lytle & Story 2005a). Sometimes, such an index is meant to reflect the school's degree of “obesogeneity” (Swinburn & Carter 2004). While a scoring system may be a fruitful approach, Lytle (2009) has suggested that the term "obesogeneity" is unfortunate because the currently available knowledge cannot consistently identify which characteristics in the school environment are "obesity-facilitating". Only when specific "obesity-facilitating" attributes have been identified and measured and subsequently examined in causal models can we talk of the "obesogeneity" of environments. In agreement with that proposition, this thesis will highlight the positive characteristics of a school food environment and use the terminology "healthful" policies and practices.

1.7 Aims

The main aim of this study was to examine school food policies in Europe, both in terms of headmaster awareness, content of school food policies and the food-related practices followed at school. A secondary aim was to study associations between

school food policies and practices and selected health-related and demographic variables in children. Studied attributes of school food policies and practices and possible associations between variables are illustrated in Figure 2 below.

The present study had three main research objectives and several specific research questions:

1) To assess headmaster awareness and school food policies and practices in nine European countries

- To what extent were school headmasters aware of school food policies at national or municipal level?
- If a policy was in place at school, what was the content?
- What were the food-related practices at school?
- Were there any associations between headmaster's awareness of national or regional school food policies, the existence or content of a policy at the school and the reported food-related practices at the school?

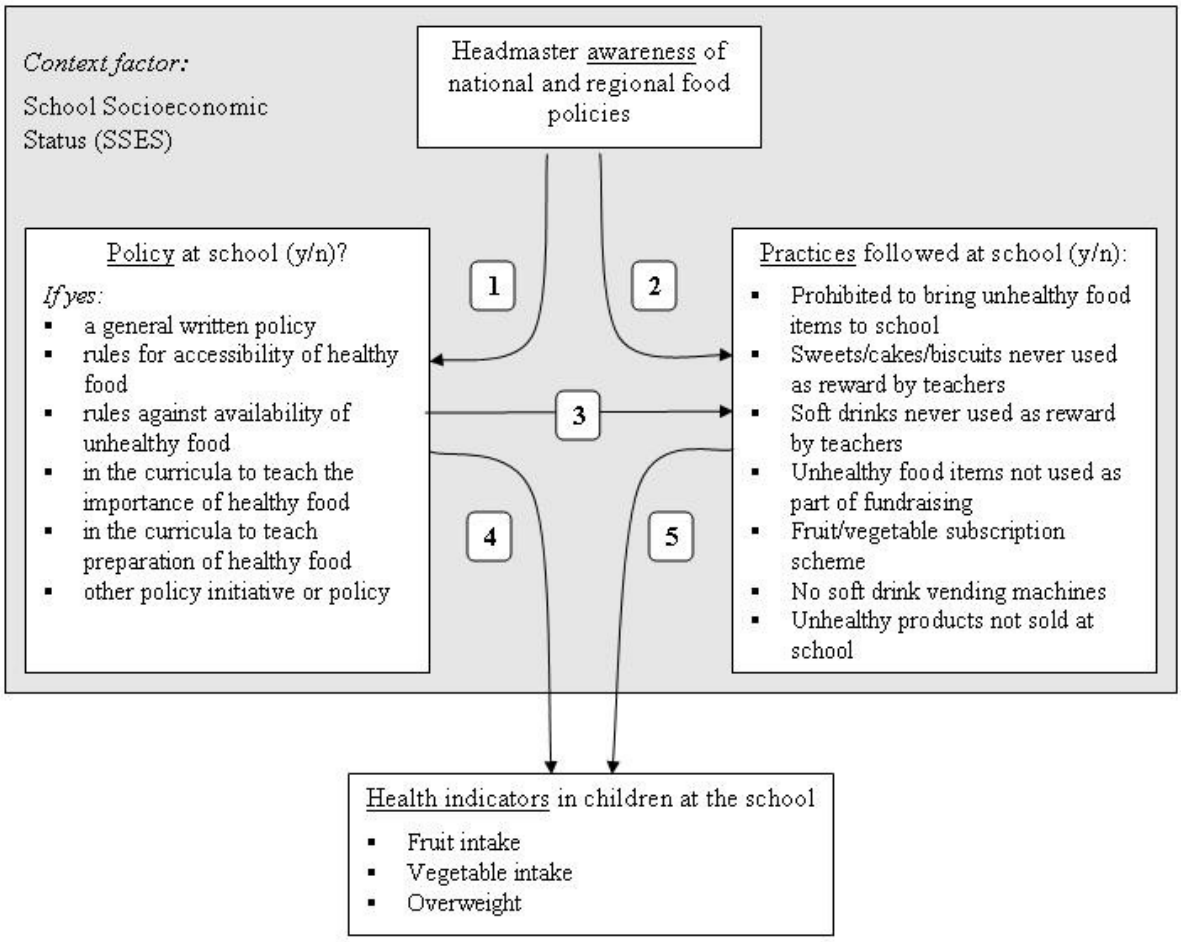
2) To examine whether there was an association between headmaster awareness, school food policies or practices and school socioeconomic status (SSES)

- Were there any associations between headmaster awareness, school food policies or practices and the percentage of children who come from families with a low income?

3) To examine whether there were any associations between school food policies or practices and selected health indicators in children

- Was there an association between school food policies or practices and children's total daily consumption of fruit and vegetables?
- Was there an association between school food policies or practices and the prevalence of overweight children?

Figure 2 Attributes of school food policies and practices and studied associations



2. Methods

This study is part of the Pro Children Project, of which the overall objective was to develop effective strategies to promote adequate consumption levels of fruit and vegetables among young adolescents and their parents.[3]

2.1 The Pro Children Project

The Pro Children Project – "Promoting and Sustaining Health through Increased Vegetable and Fruit Consumption among European Schoolchildren" – is a comprehensive research project funded by the European Commission and involving ten partner institutions in the following nine European countries - Austria, Belgium, Denmark, Iceland, the Netherlands, Norway, Portugal, Spain and Sweden. The main components of the project were carried out between April 2002 and March 2006 through two main phases. The main objective of the first phase was to assess fruit and vegetable consumption and determinants of consumption among 11-year-old school children and their parents in all nine countries, by use of cross-sectional surveys (CSS). The main objective of the second phase, limited to three of the countries (the Netherlands, Norway and Spain), was to design, implement and evaluate an intervention programme aiming to produce a 20% increase in the consumption of fruits and vegetables among participating children and parents.

A detailed description of the aims and theoretical framework of the Pro Children Project can be found in Klepp *et al*. (2005). Main findings from individual level data in the Pro Children CSS are reported in a series of articles (Sandvik *et al*. 2005, Wolf *et al*. 2005, De Bourdeaudhuij *et al*. 2006; 2007, Klepp *et al*. 2007, Yngve *et al*. 2008).

[3] The Pro Children questionnaires and protocols can be accessed at: www.prochildren.org

2.2 Study samples

The data employed in this study derive from the CSS in phase one of the Pro Children Project where three questionnaires were used – one for children, one for parents and one for school staff. Data collections were carried out between October and December 2003 in all nine countries.

Schools were used as sampling unit and from each country, samples of at least 20 schools and a minimum of 1,300 eligible children and their parents were included. The children samples were nationally representative for all countries except for Austria and Belgium, where the samples were representative of the eastern region and of Flanders, respectively. A total of 375 schools participated in the CSS.

School level data, retrieved from the school staff survey, was sufficient to answer research objectives one and two of the present study. To meet research objective three, data from the three surveys were matched. Data on children's fruit and vegetable intake was retrieved from the child questionnaire and data on children's height and weight was taken from the parent questionnaire.

An overview of the three study samples of the CSS is provided in Table 1 below.

Table 1 Number of participating schools, returned and completed surveys by headmasters, children and parents, by country: The Pro Children Cross-Sectional Study (CSS), 2003

Count-try[a]	School level data from staff survey			Data on children's fruit and vegetable intake from child survey			Data on children's height and weight from parent survey	
	Schools part in CSS, n[b]	Returned surveys, n (%)	Surveys incl in descr analysis, n (%)	Child-ren part in CSS, n[c]	Surveys incl in analysis of fruit intake, n (%)	Surveys incl in analysis of veg intake, n (%)	Valid parental resp, n (%)	Surveys incl in analysis n (%)
NO	52	51 (98)	51 (98)	1,347	1,149 (85)	1,120 (83)	742 (55)	638 (47)
ES	37	36 (97)	33 (89)	1,410	1,163 (82)	1,135 (80)	679 (48)	586 (42)
IS	32	32 (100)	32 (100)	1,392	1,113 (80)	1,102 (79)	705 (51)	667 (48)
DK	59	59 (100)	59 (100)	2,111	1,875 (89)	1,829 (87)	1,109 (53)	911 (43)
PT	27	19 (70)	19 (70)	2,535	1,576 (62)	1,553 (61)	896 (35)	744 (29)
AT	23	20 (87)	20 (87)	1,857	1,568 (84)	1,552 (84)	1,138 (61)	1088 (59)
NL	49	49 (100)	49 (100)	1,396	1,095 (78)	1,087 (78)	694 (50)	616 (44)
SE	46	44 (96)	44 (96)	1,752	1,323 (76)	1,300 (74)	879 (50)	826 (47)
BE	50	50 (100)	45 (90)	1,604	1,238 (77)	1,213 (76)	916 (57)	897 (56)
Total	375	360 (96)	352 (94)	15,404	12,100 (79)	11,891 (77)	7,758 (50)	6,973 (45)

[a] NO=Norway, ES=Spain, IS=Iceland, DK=Denmark, PT=Portugal, AT=Austria, NL=Netherlands, SE=Sweden, BE=Belgium (Flanders). [b] Source: Klepp *et al*. (2005). [c] Source: Yngve *et al*. (2005).

Abbreviations: part=participating, CSS=cross-sectional study, incl=included, descry=descriptive, veg=vegetables, resp=respondents

2.3 Instruments

2.3.1 School level data

The aim of the staff survey, directed at headmasters, was to assess school level opportunities and barriers related to fruit and vegetable consumption (Klepp *et al.* 2005). The questionnaire contained 23 questions related to lunch breaks, food availability, shopping in the area around the schools, food policies and the use of incentives/rewards (see Appendix 2).

Headmaster awareness and school food policies

Two questions were used to assess the awareness of the headmaster of any national or regional "diet/food/nutritional policy"[4] for schoolchildren and one question with a follow-up question assessed the existence and content of a policy at the school itself. For a full description of the questions and response categories, see Appendix 1 (Article) and Appendix 2 (Staff Questionnaire).

School food practices

Seven variables from the staff questionnaire were used to assess the food-related practices at school. The selection of items to be included was based on a judgement of whether or not the variables could be interpreted as reflecting a food practice that either encourages or discourages healthy eating habits. Answers from all these questions were dichotomised, leaving seven binary variables for analysis. For a full description of the questions and response categories, see Appendix 1 and Appendix 2.

[4] "diet/food/nutritional policy" is abbreviated to "food policy" throughout this thesis.

School socioeconomic status

One question in the staff questionnaire required respondents to estimate the proportion of children at their school who come from families with few economic resources, based on eight frequency categories.

2.3.2 Individual level data

Fruit and vegetable intake in children

Four questions in the Pro Children food frequency questionnaire assessed children's usual intake of fresh fruit, salad or grated vegetables, other raw vegetables and cooked vegetables. As described more fully in Appendix 1, for analyses with both fruit and vegetable intake, schools were grouped according to the proportion of children at the school who ate at least one portion of fruit or one portion of vegetables a day.

Prevalence of overweight in children

Children's weight and height, reported by their parents in the Pro Children parent questionnaire, were used to calculate children's BMI. The age- and gender specific cut-offs for defining overweight and obesity in children recommended by the International Obesity Task Force (IOTF) were used (Cole *et al*. 2000). The children's BMI data were then used to calculate the proportion of overweight (including obese) children at each school.

2.4 Data treatment and analysis

Survey material for the cross-sectional study was originally developed in English, then translated into all relevant languages and back translated for validation. Data were entered at national centres according to a standardized protocol and then processed and controlled at the Data Management Centre at University of Vienna

(Yngve *et al*. 2005). The questionnaires for children and parents were tested for validity and reliability in multiple pilot tests prior to use, as reported in Haraldsdóttir *et al*. (2005) and Kristjansdottir *et al*. (2006). The staff questionnaire was checked by face validity.

School level data, retrieved from the staff questionnaire, was used to describe the existence and nature of school food polices and the food-related practices followed at school and to get an estimate of the proportion of children who came from families of low socioeconomic status. As illustrated in Figure 2 above, school socioeconomic status was hypothesized to be linked to the other school level variables.

Individual level data on children's fruit and vegetable intake and their height and weight was taken from the child and parent questionnaires, respectively. The individual data were aggregated to school level by calculating the proportion of children with a specific behaviour or outcome and all analyses were carried out at school level only.

The three measures using the school's proportion of children with a specific outcome at school, i.e. the proportion of daily fruit and vegetable consumers and the proportion of overweight children were analysed by dividing the samples into tertiles (by using visual bander). Schools in the highest tertile, i.e. the 33.3% of schools with the highest proportion of children with the specified outcome, were given value 1 and schools in the other two tertiles were given value 0. In the regression analyses, the odds ratio (OR)[5] of schools belonging to the highest tertile were calculated for various predictor variables (policy and practices).

Also SSES was studied by dividing the sample into tertiles. However, since SSES was not studied as an outcome variable in the regression analyses but as a potential confounding predictor variable, the variable was inserted in the model as tertiles. The lowest tertile (schools with the lowest proportion of disadvantaged children) was used

[5] Odds Ratio (OR) is frequently abbreviated to "odds" throughout the thesis.

as reference category and the odds for predicting a positive outcome (=1) for the studied outcome variable (e.g. fruit intake) if the school was in the highest tertile as compared to the lowest tertile was reported.

The terms "predictor" and "outcome" variables are used instead of "independent" and "dependent" variables. This is in agreement with Field (2009) who proposes that since we do not manipulate any variables in cross-sectional research and we cannot make causal statements it is not meaningful to speak of independent and dependent variables since they are all in a sense dependent variables. According to him, since statistically we can use variables to make predictions about other variables without necessarily implying causality, this was seen as suitable terminology in this study.

2.5 Statistics

All statistical analyses were conducted using SPSS 14.0. For details of the statistical analyses, refer to Appendix 1.

3. Summary of Results

3.1 Article

Results are reported in the article presented in Appendix 1. Below is a short summary of the main findings.

Characteristics of the sample

School management participation rate was 96%, ranging from 70% in Portugal to 100% in Iceland, Denmark, the Netherlands and Belgium. Eight questionnaires were excluded in the data cleaning process since they were incomplete (less than half the relevant questions were answered) or because they could not be traced to a school, yielding a total of 352 staff questionnaires for analysis.

Awareness, policy and practices

Forty percent of the headmasters in the sample were aware of either a national or regional policy related to food in school and 61% of all the schools had their own policy. Teaching the importance of healthy eating was the most frequently reported policy component across all countries (50%), followed by rules related to the availability of unhealthy food (37%). Restricting vending machines was the most frequently followed practice (91%), reported consistently across all but two countries.

Schools at which the headmaster was aware of a national or regional policy were more than three times as likely to have their own school food policy (OR = 3.53). Headmaster awareness was also positively related to having restrictions on what foods could be brought to school (OR = 2.09) and having a fruit and vegetable subscription scheme (OR = 1.99) and negatively related to restricting what foods could be used as part of fundraising (OR = 0.60).

School socioeconomic status (SSES)

SSES was significantly associated with the practice of never using soft drinks as reward (χ^2 (1) = 4.14, P < 0.05) and of restricting the sale of unhealthy foods at school (χ^2 (1) = 6.42, P < 0.05). SSES was not significantly related to either awareness or having a policy at school. Among the health indicators, SSES was only significantly related to the proportion of overweight children (tertiles), (χ^2 (4) = 16.75, P< 0.005).

Health indicators in children

After controlling for country, neither the existence of a policy at school nor following any of the studied healthful food practices were related to having a high proportion of frequent fruit or vegetable consumers at school or a low proportion of overweight children. The only significant factor associated with the proportion of overweight children at school was having a high proportion of children from low-income families (OR = 3.33).

4. Further discussion

4.1 Headmaster awareness, school food policies and practices

The study showed that headmaster awareness of national or regional policies on food in school was clearly associated with having a policy at own school. The association was strongest if the headmaster was aware of a national policy and the association was further strengthened if the headmaster was familiar with the content of the policy, both for awareness of policy at national and regional level.

Awareness was also positively associated with some of the healthful food practices at school. However, a high correlation (Pearson's $r > 0.5$) between the different practices was only found between having no soft drink vending machine and restrictions on the sale of unhealthy foods at school. This correlation would be expected, but it was surprising that that the other healthful practices were not more highly correlated. A score of the seven practice variables was created but following five or more of the healthful practices was not significantly associated with any of the other variables studied. This lack of correlation between the practices is likely explained by the wide variation in practices across the countries.

Whereas this study did not assess the extent to which headmaster awareness matched the actual situation in all the countries, a few countries may serve as case examples. In Norway national guidelines for food in school have existed since 2001 (Holthe, Larsen & Samdal 2009 (*in press*)). However, the Regulation on environmental health in kinder-gardens and schools (Forskrift om miljørettet helsevern i barnehager og skoler) of 1995 laid down basic provisions regarding meals in schools and recommended that schools apply the National Nutrition Council's guidelines for food in schools. At the time of the Pro Children CSS study in 2003, 30% of the participating headmasters in Norway did not know whether there was a national

policy in place. While 42% said that they were familiar with the content of the policy, 24% answered that there was no policy. Two headmasters knew about the existence of the policy but not its content. In comparison, in a nationally representative survey of primary school headmasters in 2000, 65% said they were aware of the National Nutrition Council's guidelines for food in schools and 72% said they were aware of the Regulation on environmental health in kinder-gardens and schools (Bjelland & Klepp 2000). It is difficult to explain this large difference, but at least from the Pro Children study there seems to have been a potential to communicate the existence of the policy better.

Both in the Netherlands and Belgium, rather few headmasters were aware of a national policy (14% and 25% respectively), which is reasonable given the situation of strong regional autonomy and also high degree of autonomy at school level.[6] In Sweden, national guidelines for school lunches existed in 2001, but whether this would be seen as a national policy on food in school is questionable. Whereas 40% of headmasters in Sweden said they were aware of a national policy, 60% said they were not, which may demonstrate that there is a challenge of defining what constitutes a "policy".

Overall, only 40% of the headmasters in the Pro Children project were aware of either a national or regional policy in 2003. Since a number of recommendations and tools to develop school food policies have been made since then (WHO 2004; 2006a; 2006b; 2008c; 2009b), a current comparison with the 2003 data would give interesting insight in policy development in this area. In fact, developments in this area may be rapid; a national survey in Denmark in 1999 found that only 3% of schools had a written general policy (Lissau & Poùlsen 2005), whereas 4 years later 19% of the schools in the nationally representative sample in the Pro Children study reported to have a written policy.

[6] Information from the Netherlands provided by Eeuwe Lieuwes Engelsman (personal communication) and from Belgium by Lea Maes (personal communication).

Whereas the answers provided by headmasters and other school staff did not significantly differ, it would be interesting to know how school teachers' responses may have differed to the responses given by headmasters, especially about the food-related practices followed, but also their awareness, opinions and attitudes, to allow for an assessment of the potential impact they may have as role models at school, and also as a validity testing of how aware the headmaster is of the food-related practices followed by his or her teachers.

4.2 School socioeconomic status

As depicted in Figure 2, it was hypothesized that estimated SES among the children at school could be associated with awareness, policy or practices at school level since it may be assumed that schools with a high proportion of socio-economically disadvantaged children would have other priorities than healthful food. However, this study showed that SSES was not associated with either awareness or having a policy at school and only associated with two of the practice variables; high SSES was associated with never using soft drinks as reward and of restricting the sale of unhealthy foods at school. The same hypothesis was made and not supported by findings in a US study (Finkelstein, Hill &Whitaker 2008).

This study relied on headmaster estimates of the proportion of socio-economically disadvantaged children. Although this approach introduces some uncertainty, there are several reasons why this may be a valuable approach. Headmasters are assumingly quite aware of how the children at their school are doing in terms of performance but also their demographics in comparison to nearby schools, and even if the estimate is not accurate, the estimates were thought to be good enough for the purpose of ranking the schools in this study. Additionally, the difficulty of children to estimate their parents' income level or occupation (Sandvik *et al*. 2009) and the risk of high attrition rate and overestimations by parents' self-reporting of their socioeconomic background made headmasters' estimations the best option for this study.

As suggested by the finding that headmasters indicate that the proportion of children coming from low-income families is lower than the proportion provided by other school staff, there is still the risk that headmasters underestimate negative characteristics at his or her school and exaggerate the positives. If municipal data were available, this would have provided a good validity test of the SES estimates provided by headmasters.

4.3 Health indicators in children

Fruit and vegetable intake

The analyses with fruit and vegetable intake could potentially have detected associations between school level policies and practices and proportions of daily consumers of fruit and vegetables, as the sample size was relatively large and some previous studies have identified links between school level variables and daily consumption (Bere *et al*. 2007, Kubik *et al*. 2003, Briefel *et al*. 2009). However, the lack of associations in this study should not be interpreted as a *de facto* lack of such links but instead as lending support to the understanding that a policy at school or healthful food practices at school level alone may not be strong influences on children's daily fruit and vegetable intake, since there is a myriad of factors working together. Previous findings from the Pro Children study (Sandvik *et al*. 2005) show that there were large between-country differences in availability of both fruit and vegetables at school, but since the measure used in this study was the children's total intake, differences in availability at school level would not necessarily have a big impact. These findings were not surprising in light of previous research identifying availability and accessibility of fruit and vegetables and parental intake and involvement as among the most important environmental correlates of children's fruit and vegetable intake (van der Horst *et al*. 2007). Such findings have also been echoed in the Pro Children (De Bourdeaudhuij *et al*. 2007) and other studies (Vereecken, Bobelijn & Maes 2005) in which school availability of fruit and vegetables was not

found to be a significant predictor of children's intake. Moreover, in a sub-sample of Danish schools in the Pro Children Project, Krølner *et al*. (2009) actually found higher consumption of fruit among children at schools with no fruit available, potentially reflecting that parents compensate for low availability at school with providing their children with fruit from home.

The finding in this study that neither fruit nor vegetable intake were associated with SSES, was however surprising and also contrary to other studies (Vereecken *et al*. 2005, WHO 2008a, Sandvik *et al*. 2009).

Overweight

This study found that having a high proportion of overweight children at school was significantly associated with lower SSES. This is in line with findings from another study in the Pro Children project (De Bourdeaudhuij *et al*. 2006) in which a significant relationship was found between family education level and overweight in children.

The link between overweight and low SES is not surprising. The final report of the Commission on Social Determinants of Health, set up by WHO in 2005, provides a clear diagnosis for differential health outcomes (WHO 2008d):

> "This unequal distribution of health-damaging experiences is not in any sense a 'natural' phenomenon but is the result of a toxic combination of poor social policies and programmes, unfair economic arrangements, and bad politics. Together, the structural determinants and conditions of daily life constitute the social determinants of health and are responsible for a major part of health inequities between and within countries."

According to the Commission, the global obesity epidemic is "a good example of a socially patterned health outcome that is a consequence of changes in a constellation of social factors". Due to the interconnected nature of the causes of obesity,

coordinated policy and action among health and non-health sectors is needed, along with strong community-level action.

Due to the high number of schools being excluded for the regression analysis, a missing data analysis was performed to check the possible impact of excluding the high number of schools (n = 77) where less than 50% of the children had parental reports of height and weight and/or less than 5 at the school had this reported by their parents. When all schools were included in the overweight regression model, having a policy at school and having a fruit/vegetable subscription scheme, both significantly reduced the odds of being in the category of schools with the highest proportion of overweight children. This relationship remained also when SSES was added to the regression model but when country was added only having a fruit/vegetable subscription scheme remained a significant predictor of having a lower proportion overweight. These somewhat different results are most likely due to the change in proportions of overweight children in the countries where many schools were excluded in the main analyses. This was true for 18 schools in Norway, 16 in Denmark and 15 in the Netherlands. By looking at the proportion overweight children at the schools where less than 5 children had valid BMI, the proportions were 27% in Norway (11 schools), 19.4% in Denmark (3 schools) and 15.4% in the Netherlands (13 schools), which would introduce error since the cases are not weighted in these analyses. Whereas the proportion of overweight for the whole sample remained the same for the schools in Denmark, it increased substantially in Norway and the Netherlands. The altered results when all schools were included in the overweight regression analysis can therefore be discarded and the decision to set quite strict inclusion criteria for schools in the analysis of overweight prevalence seems justified.

4.4 Strengths and weaknesses

The strengths of this study include its large international sample, with nationally representative data for nine countries gathered at both individual and school level. A

high participation rate was obtained both for the child, parent and headmaster questionnaires. The study offers new insight into similarities and differences between and within the participating countries in terms of headmaster awareness, policies and practices, which have been sparsely studied. Whereas the data derive from 2003, all questionnaires were filled in within a short time span (3 months), using standardized questionnaires across the nine countries, which is important in correlational research. Lastly, as pointed out by Field (2009), a general strength of correlational research is the fact that questions are studied in a natural situation since nothing is manipulated and there is therefore no researcher-bias, giving the study ecological validity.

Some weakness must also be noted. Perhaps most importantly, the cross-sectional design of this study begs caution with interpreting the results as anything more than possible associations between variables. No causal mechanisms can be proposed despite the assumptions about the direction of certain relationships in this study. For example, whereas, as depicted in Figure 2, headmaster awareness of national or regional policies may influence headmasters to implement these or develop policies at their own school, which potentially could influence food-related practices and in the long run behaviour and certain health outcomes in children, the relationship might just as well go the other way; if the headmaster observes high numbers of overweight children at his or her school he/she might decide to take certain steps and in that process consult possible national and regional policies.

The main instrument used in this study, the staff questionnaire, seemed to have some weaknesses. The fact that 12 headmasters across seven countries had not answered or answered “no” to the question about whether or not the school had a policy but then provided the specific content of the policy in the follow-up question, suggests that this question could have been formulated in a better way. There was no definition of “policy” in the questionnaire and it is likely that this term has been difficult to interpret, e.g. some headmasters may have answered "no" to the main question on the existence of a policy because they did not notice that e.g. teaching the importance of healthy food in the curricula was interpreted in this study as being a component of a

policy. Furthermore, it may be questioned whether this component, being the most frequently reported policy component, should be seen as a component of a school policy at all. In many countries, curricular content is determined at federal, state, or local level, and may not be a decision taken at school level. Under such circumstances, this question would not necessarily have measured involvement with healthful eating at school level. However, the question still provided an overall indication of a focus on healthful eating at school, although not necessarily because of an engaged headmaster. The fact that the food-related practices reported seemed more consistent within countries than the policies may suggest that the questions about practices better reflected general norms around food in school within countries than a policy. A more comprehensive validity testing of the questionnaire could potentially have improved the policy question and a more detailed study into the exact content of the school policy would be warranted.

The categorization of "policies" versus "practices" may also benefit from a thorough discussion. In the recent systematic review on effectiveness of school food and nutrition policies by Jaime & Lock (2009), the Pro Children study itself qualified for inclusion because health behaviour intervention studies were included in the review. It may be argued that effects of time-limited health behaviour interventions offered to schools by research teams are quite different from effects of policy initiatives taken at school level. The latter may better reflect a concerted school effort at following healthful food practices and better mirror prevailing norms around eating in school.

Another issue related to the questionnaire is the question of how well the headmasters provide a valid picture of the situation at his or her school, as especially for large schools this could vary. Questionnaires given also to teachers at the same schools would be an interesting validity test of consistency in answers given by a headmaster vis-à-vis teachers at the same school.

The challenges associated with self-reported fruit and vegetable consumption among 11-year olds, such as difficulty with recall, social desirability and observer bias (Sa & Lock 2008) should be noted as well as uncertainties associated with parental reports

of children's height and weight (De Bourdeaudhuij *et al*. 2006). However, a more important limitation in this study was the limited amount of data on height and weight. Since only 45% of the total number of children who participated in the CSS could be included in this study, the analyses with proportion overweight were severely compromised. In the same context, the study would have been strengthened if the staff questionnaire assessed school level opportunities and barriers related to physical activity in addition to fruit and vegetable consumption.

The statistical approach taken in this study was not ideal. Since both individual and school level data were available for nine countries, a more sophisticated statistical approach which could take account of variance in the data at all three levels could have offered better insight into the studied associations. Furthermore, the statistical testing used in several of the analyses in this study, identifying ORs through logistic regression, required dichotomizing of answers, whereby some variation is lost, also in the descriptive part of this study.

4.5 Implications for future research and practice

Further to discussion in Appendix 1, findings in this study suggest that further research into school staff awareness, (also beyond headmaster) is warranted, as well as a better understanding of what role this may play for health-related behaviour in children at those schools.

The WHO *School Policy Framework* (WHO 2008c) proposes that in evaluating some of the long term effects (outcome indicators) of having implemented a school food policy, e.g. the percentage of children who are overweight or obese, may take 5-10 years. Evaluating how the implementation of a policy might affect fruit and vegetable consumption is proposed as an intermediate term outcome indicator, taking 2-5 years. Thus, in order to gain better insight into the effects or implications of school food policies and practices, longitudinal studies would be required, which include baseline

data of cognitive, behavioral and physical measures of schoolchildren before new measures are introduced and at several follow-up evaluations after.

Although norms around food and eating to some extent may be reflected in healthful practices followed at a school, the influence of teachers should not be underestimated (Kubik *et al*. 2002). Health promotion for school staff is suggested as one important component in the WHO *School Policy Framework* (WHO 2008c), pointing out that teachers need to be aware of and responsible for the messages they give as role models to children and others.

The latest Cochrane Review of interventions for preventing obesity in children (Summerbell *et al*. 2005) points to the need for well designed evaluations of "upstream" factors, including factors such as food availability, financial options for healthier food and activity options, safe play spaces and school-community partnerships. The need for more research on community-based change strategies to make positive changes in children's food environment has also been echoed by others (Kubik, Lytle & Story 2005b). One community-based intervention which has already shown positive effects on reducing childhood obesity is the French project EPODE (Ensemble Prévenons l'Obésité Des Enfants) (Romon *et al*. 2009), a public private partnership now being rolled out in several other countries in Europe and beyond (Australia and Mexcico). Evaluations of the EPODE programme[7] and other community-based programmes may help us understand which factors in the food environment surrounding children that are of greatest importance.

While the question has been raised at to whether it is time to move health promotion efforts outside the school-setting (Krølner *et al*. 2009, Gittelsohn & Kumar 2007), this study suggests that there is a large potential to further improve children's food environments in the school setting, and even if other factors, such as larger parental involvement (Krølner *et al*. 2009) my be warranted, there is also potential to expand

[7] The EPODE website: http://www.epode.fr. For information on EPODE in Europe: www.epode-european-network.com/ (both accessed 20 November 2009)

the school level efforts. As recognized by the WHO *School Policy Framework* (2008c) and others (Haugland 2005), the school health service may play an important part of the combined health promotion efforts through schools. This service has the ability to work systematically with the school, over a long period of time, and with activities that can support children facing special challenges in their everyday life. Future research could shed better light on how the school health service could me better integrated in school-based initiatives.

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Appendix 1 – Article

School food policies and practices in nine European countries: The Pro Children Project

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Short title: School food policies and practices in Europe

Abstract

Background/Aims

Schools offer an important setting for prevention of noncommunicable diseases through its potential to support the development of healthy habits in children. The aims of this study were to examine headmaster awareness of national or regional policies and the association of this with school food policies and practices, and to assess whether having a school food policy or healthful food practices were associated with fruit and vegetable intake and overweight in children.

Methods

The Pro Children cross-sectional survey of school headmasters (n = 352) from nationally representative samples in nine European countries was conducted in 2003. School level data were matched with data on 11-year old children from child and parent surveys undertaken in the same schools. Descriptive statistics were used to examine awareness, existence and content of school polices and practices and logistic regression was used to study possible associations between school policies and practices and indicators of children's health.

Results

Forty percent of headmasters were aware of either a national or regional policy related to food in school and 61% of all the schools had their own food policy. Teaching the importance of healthy eating was the most frequently reported policy component and restricting vending machines was the most frequent practice. Headmaster awareness of a national or regional policy increased the likelihood of schools having their own policy (OR = 3.53). Neither policy nor practices were associated with the health outcomes in children. Having a high proportion of children from low-income families was associated with a high proportion of overweight children at school (OR = 3.33).

Conclusion

Headmaster awareness of national or regional policies related to food in schools increases the likelihood that the school has its own policy and that certain healthful practices are followed. Whereas this study did not find any significant associations between school level policy or practices and health outcomes in children, further research on possible links is warranted, preferably applying longitudinal design with assessment of effectiveness and cost-effectiveness of implemented policy changes.

Introduction

Fruit and vegetable intake among schoolchildren in Europe has been identified as too low, and the proportion of overweight and obese children as too high, by the 2005/2006 Health Behaviour in School-Aged Children (HBSC) study (WHO 2008a). Both a low fruit and vegetable intake and being overweight constitute important risk factors for noncommunicable diseases (NCDs) (WCRF 2007, WHO 2003; 2009a) and for both these health indicators, undesirable outcomes during childhood seem to track into adulthood (Dietz 1998, Knai *et al*. 2006). Studies consistently show that children from families of low socioeconomic status (SES) consume less fruit and vegetables and are more likely to be overweight (WHO 2008a; 2008d).

Schools have a unique opportunity to reach all children and also their families and wider community and they can at the same time influence personal, social and physical determinants of children's health behaviour. Furthermore, the school offers an arena in which children from all socioeconomic and cultural backgrounds meet the same norms and practices (French & Stables 2003, Klepp *et al*. 2005).

In the World Health Organization (WHO) Global Strategy on Diet, Physical Activity and Health, endorsed by all the 192 WHO Members States in 2004, governments were encouraged to "adopt policies that support healthy diets at school and limit the availability of products high in salt, sugar and fats" (WHO 2004). Several tools exist to support the development of school nutrition policy and programmes (WHO 2006a; 2006b; 2008c; 2009b). However, the evidence of what are the most effective components of a school food or nutrition policy is still limited, and the evidence of cost-effectiveness nearly absent (Jaime & Lock 2009).

A recent review (Jaime & Lock 2009) identified most evidence for an impact of nutrition guidelines on decreasing fat and increasing fruit and vegetable availability in school food provision and on improving children's dietary intake. The evidence for effects of regulation of food and beverage availability was limited but also inconsistent but several price intervention studies have shown an effect, e.g. that free

or subsidized fruit and vegetable subscription programmes have increased schoolchildren's consumption (Bere *et al*. 2007). A recent review of various types of school-based fruit and vegetable intervention programmes (30 studies) in Europe found that 70% of the studies showed increased fruit and vegetable intake at follow-up (from 3 to more than 24 months) (Sa & Lock 2008). A few interventions have shown an impact on children's BMI but they are often multi-component interventions and of long duration (e.g. Foster *et al*. 2008).

A few cross-sectional studies have found associations between school food policies or practices and health indicators in children (Kubik, Lytle & Story 2005a, Fox *et al*. 2009, Briefel *et al*. 2009). However, to our knowledge, there is no multi-country study to date that has assessed school food policies and practices and studied associations with children's fruit and vegetable intake and weight at the same schools.

The aims of this study were to examine school food policies in Europe, both in terms of headmaster awareness, content of school food policies and what food-related practices were followed at school and to assess whether having a school food policy or healthful food practices were associated with fruit and vegetable intake and overweight in children.

Methods

Sample and procedure

The data employed in this study derive from the cross-sectional study of the Pro Children Project (Brug, Yngve & Klepp 2005). The project involved 11-year old children (n = 15,400), the children's parents and school management staff in nine European countries (Austria, Belgium, Denmark, Iceland, the Netherlands, Norway, Portugal, Spain and Sweden). Schools were used as sampling unit and from each country, random samples of at least 20 schools and a minimum of 1,300 eligible children and their parents were included. The samples were nationally representative for all countries except for Austria and Belgium, where the samples were representative of the eastern region and of Flanders, respectively.

Most of the data used in the present study derive from a school staff survey directed at headmasters. The aim of the staff survey was to assess school level opportunities and barriers related to fruit and vegetable consumption (Klepp *et al*. 2005). Data on children's fruit and vegetable intake and children's height and weight were taken from the child and parent questionnaires, respectively, and matched with data from the headmaster questionnaire. Main findings from individual level data in the Pro Children cross-sectional surveys are reported in a series of articles (Sandvik *et al*. 2005; De Bourdeaudhuij *et al*. 2006; 2007, Klepp *et al*. 2007, Yngve *et al*. 2008, Wolf *et al*. 2005).

The cross-sectional surveys were carried out between October and December 2003 in all nine countries. Survey material was originally developed in English, then translated into all relevant languages and back translated for validation. Data were entered at national centres according to a standardized protocol and then processed and controlled (Yngve *et al*. 2005). A detailed description of the aims and theoretical framework of the Pro Children Project can be found elsewhere (Klepp *et al*. 2005).

Measurements

Headmaster awareness, school food policies and practices

The staff questionnaire was distributed to headmasters but could also be answered by other school staff. For practical reasons the respondent is referred to as headmaster throughout this paper. Data from the staff questionnaire were used to study headmaster awareness, school food policies and practices (the questionnaire is available upon request). The staff questionnaire was checked by face validity. Headmasters awareness of food policies was assessed through two questions: 'Is there a national diet/food/nutritional policy for schoolchildren?' and 'Does the municipality have a diet/food/nutritional policy for schoolchildren?' For both, the response alternatives were: 'I do not know', 'no, there is no national policy', 'yes, but I am not familiar with it' and 'yes, and I am familiar with it'. "Awareness" in this paper refers to the last two response alternatives.

For information about their own school, headmasters were asked whether or not the school had a diet/food/nutritional policy for the pupils. For those who answered 'yes', a follow-up question on the content of the policy included the multiple-answer response alternatives: 'a general written policy paper', 'rules for accessibility of healthy food at the school (e.g. fruit and vegetables'), 'rules against availability of unhealthy food items at school (e.g. sweets and soft drinks)', 'time in the curricula to teach about importance of healthy food habits', 'time in the curricula to teach the children how to prepare healthy food' and 'other policy initiatives or activities'.

Seven variables from the staff questionnaire were used to assess school food practices. Items were selected based on a judgement of whether or not responses to the variable could be interpreted as reflecting a food practice that either encourages or discourages healthy eating habits. Answers from all these questions were dichotomised, leaving seven binary variables for analysis.

The question 'If any, what food and/or beverage items are pupils not allowed to bring to school?' had five multi-answer response alternatives: 'cakes/biscuits', 'sweets', 'chocolate/chocolate bars', 'soft drinks' and 'other'. If the school prohibited 4 or 5 of these items, it was considered as prohibiting children from bringing unhealthy food items to school and given value 1. If the school prohibited 3 or fewer items, it was given value 0.

Two questions assessed practices related to the use of rewards: 'How often do teachers at your school use sweets/cakes/biscuits as a reward?' and 'How often do teachers at your school use soft drinks as a reward?' The two questions had the same three single-answer response alternatives: 'never', 'on some occasions' and 'often'. The two last response alternatives were collapsed for both questions so that schools which never use sweets/cakes/biscuits, or soft drinks, as reward, were given value 1 and all the others were given value 0.

The question: 'What can be sold at this school as part of school fundraising?' had the following multi-answer response alternatives: 'cakes/biscuits', 'sweets',

'chocolate/chocolate bars', 'chips', 'soft drinks' and 'fruit'. The schools which did not allow any of the food items, or only fruit, were given value 1 and those which allowed one or more unhealthy food items were given value 0.

A question about the existence of various subscription programmes available for 11-year-olds included fruit/vegetables schemes as one of the items. The four single-answer response alternatives were: 'no', 'yes, all parents who want it need to pay for it', 'yes, wealthier parents pay but free for low income children' and 'yes, without charges for all children'. The schools which had some sort of fruit/vegetable subscription scheme were given value 1 and value 0 was given if no scheme existed.

One question assessed the existence of various vending machines for children to use at school. Schools which had vending machines for soft drinks were given the value 0 whereas schools which did not have them were given the value 1.

Headmasters were asked to indicate how often various food and drink items were available for children to buy at school. The three unhealthy food items included in the questionnaire (cakes or sweet biscuits, soft drinks and sweets) were selected for study. The single-answer response alternatives were: 'yes, every day', 'yes, most days', 'some days' and 'never'. The schools which never offered any of these three food items were given value 1, whereas schools which offered any of these items were given value 0.

Fruit and vegetable intake in children

Data on children's fruit and vegetable intake used in this study is taken from the Pro Children food frequency questionnaire (FFQ) (results are presented in e.g. Sandvik *et al*. 2005, De Bourdeaudhuij *et al*. 2006). A validation study of the food frequency questionnaire showed reasonable to good test-retest reliability and in general adequate validity comparing the food frequency questions with a 7 day food recording, as described by Haraldsdóttir *et al*. (2005).

Children were asked about how often they usually eat fresh fruit, salad or grated vegetables, other raw vegetables and cooked vegetables. The response alternatives, with values ranging from 0 to 7, were ‘never’, ‘less than one day per week’, ‘one day per week’, ‘2-4 days a week’, ‘5-6 days a week’, ‘every day, once a day’, ‘every day, twice a day’ and ‘every day, more than twice a day’. Children who answered ‘every day, once a day’ or a higher frequency were classified as daily consumers of fruit. For vegetables, a score based on the frequency reported for the three groups of vegetables (salad or grated vegetables/other raw vegetables/cooked vegetables) was computed for each child. As further described by Haraldsdóttir *et al*. (2005), this score took portion size (grams) of the various vegetable groups into account. Children who consumed at least one portion of vegetables daily were classified as a daily consumer of vegetables.

The data were aggregated to school level by calculating the proportion of children per school who daily (as defined above) consumed fruits and vegetables. Only children who answered all three questions about vegetables were included in the calculation of aggregated data and only schools where at least five children had completed the FFQ were included. For the analyses, schools were divided into tertiles based on their proportions of daily fruit and vegetable consumers and schools in the highest tertile were assessed against the others for both fruit and vegetables.

Prevalence of overweight in children

Children’s weight and height, reported by their parents in the Pro Children parent questionnaire, were used to calculate children’s body mass index (BMI). The age- and gender specific cut-offs for defining overweight and obesity in children recommended by the International Obesity Task Force (IOTF) were used (Cole *et al*. 2000). The children's BMI data were then used to calculate a proportion of overweight (including obese) children at each school. Again, schools in the highest tertile were assessed against the other schools.

School socioeconomic status (SSES)

The staff questionnaire included a question which required headmasters to estimate the proportion of children at their school who come from families with few economic resources (low income families, families who receive transfer income). Based on eight response alternatives, schools were divided into tertiles for analyses that included this SSES variable.

Figure 1 below provides an overview of the attributes and relationships that were studied.

Figure 1 to be inserted about here

Statistical analysis

Descriptive statistics were used to describe headmasters' awareness and school food policies and practices in the nine countries. As suggested by Field (2009), frequency tables and Pearson's chi-square test were used to study the strength of the relationships between categorical variables. Odds ratio was used to study the following relationships depicted in Figure 1: the relationship between headmaster awareness of national and regional policies and the existence of a food policy at school and the various policy components (relationship 1), between awareness and practices (relationship 2) and between policy at own school and practices (relationship 3).

One-way between-groups analysis of variance (ANOVA) was used to assess whether mean scores for selected health indicators in children and school socioeconomic status differed significantly between the countries.

Binary logistic regression analysis was used to investigate relationships 4 and 5 depicted in Figure 1, i.e. to test the predictive power of having a school food policy or of following any of the seven food-related practices on having a high proportion of children at school who a) ate at least one portion of fruit daily; b) ate at least one portion of vegetables daily; or c) were overweight. Since no assumptions were made

about the relative predictive power of any of the predictor variables, an exploratory approach was taken whereby all bivariate relationships were assessed first, using Pearson's chi-square test. Associations significant at $P < 0.25$ were inserted into a regression model. A high significance level in the first test was chosen to ensure that no possible associations were missed, as proposed by Mickey & Greenland (1989). For each outcome variable (a-c) the covariates were tested for multicollinearity. Covariates were eliminated in a stepwise manner and significant associations were reported in the first regression model if $P < 0.05$. School socioeconomic status was included in a second model in the regressions, and in the third model associations were adjusted for country.

It was not possible to conduct the analyses for each country separately due to a rather low sample size in some countries. When not otherwise stated, associations were seen as significant at $P < 0.05$. All analyses were conducted using SPSS 14.0.

Results

Characteristics of the sample

School management participation rate was 96%, ranging from 70% in Portugal to 100% in Iceland, Denmark, the Netherlands and Belgium. Eight questionnaires were excluded in the data cleaning process since they were incomplete (less than half the relevant questions were answered) or because they could not be traced to a school, yielding a total of 352 staff questionnaires for analysis. Of the 349 respondents who reported their position, 72% were headmasters, ranging from 50% in Austria to 91% in Belgium. The rest were vice headmasters or other school staff. Answers given by other school staff did not significantly differ from the responses of headmasters for any of the questions used in this study with the exception of the estimated proportions of children who come from low-income families. Headmasters reported a lower percentage of children as coming from low-income families than other school staff (data not shown).

Awareness of school food policies

Twenty-two percent of the headmasters were familiar with the content of a national diet/food/nutrition policy for schoolchildren and 11% were aware of the existence of a policy but did not know the content, thus in total 33% of the headmasters were aware of a national policy (data described in this section is not shown). Awareness ranged from 63% in Portugal to 10% in Denmark. In total 44% of the headmasters did not know whether a national policy existed in their country at the time of the survey, ranging from 64% in Belgium to 16% in Portugal. The last 24% of headmasters answered that no policy existed (45% in Denmark, 9% in Spain).

Fifty-five percent of the headmasters responded that there was no regional policy, 27% did not know whether one existed or not and only 18% were aware of a regional policy. Exceptionally, in Iceland and Sweden, 31% and 34% of headmasters were familiar with the content of a regional policy, respectively.

Forty percent of the headmasters were aware of either a national or a regional policy (or both) and 28% were familiar with the content of either a national or regional policy.

Existence and content of school food policies

As presented in Table 1, on average, across the countries, 61% of the schools had a school food policy, with high proportions in Iceland (90%), Portugal (90%), Belgium (84%) and Spain (78%) and low proportions in Sweden (38%), the Netherlands (43%) and Denmark (44%). The most common component of a school food policy was to include in the curricula lessons on the importance of healthy food, something 50% of all the schools did (ranging from 80% in Belgium to 28% in Denmark). Among the schools with a policy in place, the percentage was 81. The second most common component was to have rules or restrictions on the availability of unhealthy food, something 37% of all schools had, or 60% of those who had a policy at school. Only 17% of all schools had a general written policy, with a relatively high proportion reported only in Iceland (42%) and Spain (34%). A high correlation ($r > 0.5$) between

the different policy components was only found between having rules against the availability of unhealthy food items at school and including in the curricula to teach preparation of healthy food.

Table 1 to be inserted about here

Awareness influencing policy?

Studying relationship 1 in Figure 1 showed that the odds of having a food or nutrition policy at school were 4.00 times higher (95% CI: 2.32, 6.87) if the headmaster was aware of a national food policy for schoolchildren, as compared to not being aware of one (i.e. not knowing or thinking there was no policy). Schools with a headmaster who was familiar with the content of a national policy had 6.14 times higher odds (95% CI: 2.93, 12.85) of having a policy. However, even if the headmaster did not know whether or not a national policy existed, there was still a 56% chance that the school had a school food policy.

The odds of having a food policy at school was 2.29 times higher (95% CI: 1.22, 4.29) if the headmaster was aware of a regional policy as compared to not being aware of one and 3.18 times higher (95% CI: 1.43, 7.08) if the headmaster was familiar with the content of a regional policy.

Looking at headmasters who were aware of or familiar with either a national *or* regional policy, the odds of having a policy at own school were 3.53 times higher (95% CI: 2.15, 5.82) if the headmaster was aware and 4.52 (95% CI: 2.47, 8.30) times higher if he/she was familiar with the content(s). However, even if the headmaster was not aware of either a national or regional policy, there was still a 50% chance that there was a policy at school.

Looking exclusively at the schools with a policy in place (n = 208) the odds of having a written policy at school were 2.05 times higher (95% CI: 1.10, 3.82) if the headmaster was aware of a national or regional policy and 2.14 times higher (95% CI: 1.15, 3.98) if he/she was familiar with the content(s) of such policies. The odds of

including the policy component of including preparation of healthy food in the curricula were 1.96 times higher (95% CI: 1.11, 3.47) if the headmaster was familiar with the content of either a national or regional policy.

No significant relationships were found between the headmaster's awareness of national or regional policies and having a high number of specified policy components at school.

School food practices

As shown in Table 2, the proportions of schools in each country that followed the selected school food practices had a wide range.

Table 2 to be inserted about here

Restrictions on soft drink vending machines was on average, across the countries, the most common practice followed (91%), ranging from 100% in several countries to 25% in Austria. Overall, most schools never used soft drinks as reward (76%), ranging from all schools in Portugal to 41% of schools in Denmark. Sweets/cakes/biscuits were more commonly used as reward, except in Iceland, where 75% of schools never used such rewards. No unhealthy food or drinks were sold in any of the schools in Iceland or the Netherlands. Restrictions were also common in Sweden (86%), Norway (83%), Spain (81%) and Denmark (71%), while none of the schools in Portugal had restrictions and only 10% of the schools in Austria did. The proportion of schools reporting that unhealthy food items were not used as part of fundraising ranged from 96% in the Netherlands to 37% in Portugal.

Fruit/vegetable subscription schemes were not common overall (26%), but 77% of the schools in Sweden and 50% of the schools in Portugal provided some sort of scheme. In the rest of the countries the proportion was low, with no schools in the Netherlands and 7% in Spain having a scheme. Restrictions on what foods could be brought to school were also rare overall (19%). None of the schools in Portugal and Austria had restrictions, only low proportions did in Denmark (5%), the Netherlands (8%) and

Belgium (11%), whereas restrictions were in place in 50% of the schools in Iceland and 41% of the schools in Sweden. Forty percent of the schools followed five or more of the healthful school food practices, with high frequencies in Sweden (73%), Iceland (59%) and the Netherlands (51%). A high correlation ($r > 0.5$) between the different practices was only found between having no soft drink vending machine and restrictions on the sale of unhealthy foods at school.

Awareness or policy influencing practices?

Examination of relationships 2 and 3 in Figure 1 showed that schools with a headmaster who was aware of either a national or regional policy on food in school were twice as likely to have restrictions on what may be brought to school (OR = 2.09, 95% CI: 1.21, 3.60) and twice as likely to have a fruit and vegetable subscription scheme (OR = 1.99, 95% CI: 1.21, 3.25) as compared to schools where headmasters were not aware. However, headmaster awareness of national or regional policies also reduced the odds of having restrictions on what foods could be used at part of fundraising (OR = 0.60, 95% CI: 0.37, 0.97).

Having a policy in place at own school reduced the odds of having restrictions on the sale of unhealthy products at school (OR = 0.53, 95% CI: 0.31, 0.90). No significant relationships were found for the other food-related practices. Consideration of the number of years a policy had been in place at school did not change any of these relationships (data not shown).

School socioeconomic status (SSES)

The ANOVA-analyses showed that the proportion of children coming from low income families, as estimated in the school staff questionnaire, varied significantly between the countries. Whereas in total 28% of the schools had more than 20% children from low-income families, the proportion varied between zero in Norway and 79% in Portugal. With schools divided into tertiles, chi-square tests showed that higher SSES was significantly associated with the practice of never using soft drinks as reward (χ^2 (1) = 4.14, $P < 0.05$) and of restricting the sale of unhealthy foods at

school (χ^2 (1) = 6.42, P < 0.05). SSES was not significantly related to either awareness or having a policy at school. Among the health indicators, SSES was only significantly related to the proportion of overweight children (tertiles), (χ^2 (4) = 16.75, P< 0.005).

Fruit and vegetable intake and overweight

The numbers of valid reports of children's self reported habitual fruit (n = 12,100) and vegetable (n = 11,891) intake were much higher than the number of parental reports of their children's height and weight (n = 7,758). The mean proportion of parents providing valid reports of their children's height and weight was 50% for all countries, ranging from 35% in Portugal to 61% in Austria. For the analyses with overweight as outcome measure, 77 schools were excluded due to either too few reports of weight and height (n < 5) or a too high percentage of missing BMI data (> 50%) at school, yielding 275 schools for analysis. For the fruit and vegetable analyses, 7 and 8 schools in Norway were excluded, respectively, due to a low number of children (n < 5) having completed the questions.

Table 3 to be inserted about here

Table 3 shows the distribution of frequencies in the nine countries of the three outcome variables studied in relationship 4 and 5 (Figure 1). ANOVA-analyses showed that the mean proportions differed significantly between the countries for all three outcome variables: the proportion of children who ate at least one portion of fruit a day (Welch's F (8, 345) = 12.86, P < 0.001), the proportion who ate at least one portion of vegetables a day (Welch's F (8, 344) = 16.66, P < 0.001), and the proportion of overweight (including obese) children (Welch's F (8, 275) = 8.41, P < 0.001). With the inclusion criteria used for this study, the proportion of children who ate at least one portion of fruit ranged from 32.7% in Norway to 57.6% in Portugal, the proportion of children who ate at least one portion of vegetables a day ranged from 40.6% in Spain to 65.6% in the Netherlands and the proportion of overweight children ranged from 9.5% in the Netherlands to 24.3% in Portugal.

Table 4 to be inserted about here

Results from the logistic regression analyses with health indicators in children as outcome variables are presented in Table 4. Results for the analysis of vegetable intake is not shown because no significant associations were found between having a high proportion of children at school who ate at least one portion of vegetables a day and any of the predictor variables.

Model 1 for fruit intake indicates that schools that never used unhealthy foods in fundraising had higher odds of having a high proportion of children who ate at least one portion of fruit a day (OR = 2.10, 95% CI: 1.14, 3.85) and that schools with restrictions on the sale of unhealthy foods at school had lower odds of having a high proportion of frequent fruit consumers (OR = 0.27, 95% CI: 0.16, 0.48). These associations remained significant when SSES was included in Model 2 but no associations remained significant when they were adjusted for country in Model 3.

Model 1 for proportion of overweight as outcome variable showed that schools with restrictions on soft drink vending machines had lower odds (OR = 0.45, 95% CI: 0.20, 0.99) of having a high proportion of overweight children. However, when SSES was added in Model 2 the relationship was no longer significant. SSES was a highly significant factor in explaining a high proportion of overweight children. Also after adjusting for country in Model 3, schools in the lowest SSES tertile had 3.33 times higher odds (95% CI: 1.34, 8.30) of having a high proportion of overweight children as compared to schools in the highest SSES tertile ($P < 0.005$).

Discussion

Despite agreement among policy-makers of the importance of policies that support healthy diets at school (WHO 2004) and extensive intervention research to identify effective school-based strategies, few studies to date have investigated effects of school food policies and practices in Europe (Jaime & Lock 2009). To our knowledge, this study is unique in combining data from a large and nationally

representative sample of schools in nine European countries with data on fruit and vegetable intake and prevalence of overweight among children at the same schools.

Headmaster awareness, school policy and practices

Forty percent of the headmasters in the sample were aware of either a national or regional policy related to food in school and 61% of the schools had their own policy. The most frequent policy component reported across all countries was teaching the importance of healthy eating, followed by rules related to the availability of unhealthy food. As for healthful practices, restricting vending machines was the most frequently practice followed, reported consistently across all but two countries.

By studying the relationships between headmaster awareness, policy and practices at school we found that schools where the headmaster was aware of a national or regional policy were more than three times as likely to have their own school food policy. Among the schools with their own policy in place, headmaster awareness particularly increased the odds of having a written policy and of including preparation of healthy food in the curriculum. Headmaster awareness also increased the odds of following two school practices: having a fruit and vegetable subscription scheme and having restrictions on what foods could be brought to school. Curiously, headmaster awareness also reduced the odds of restricting what foods could be used as part of fundraising. Possibly, the aware headmasters did not consider the types of food products used in fundraising as important among other daily practices and they may even have been aware of justification to occasionally use these food in fundraising provided in the national or regional policies. Fundraising may also be a welcome source of income for popular school events (Kubik, Lytle & Story 2005b) and as such be an exception to otherwise healthful practices. It is possible that the headmasters who were unaware of national or regional policies to a lesser degree considered this practice as different from the other school practices.

Only one of the food practices was associated with having a policy at school and strangely this association showed that having a policy reduced the odds of restricting

the sale of unhealthy products. A closer look showed that it was the policy component of having rules for accessibility of healthy foods that was most strongly associated with reduced odds for restricting the sale of unhealthy products, which could be interpreted as a preference for promoting healthy options instead of restricting or banning the sale of unhealthier options. Such a preference would be in line with the finding reported by (Cullen *et al*. 2006) that schoolchildren may compensate for the lack of access to some banned foods by buying other unhealthy foods. It is also possible that this effect is due to the situation in three countries (Austria, Portugal and Belgium) that had low frequencies of schools restricting the sale of unhealthy products and high frequencies of schools reporting having rules for accessibility of healthy food.

This apparent lack of association between having a food policy at school and following healthful school food practices may suggest that food-related practices at school are to a larger extent guided by norms and prevailing food culture than of having a formal policy or widely agreed rules around food in school. The fact that teaching the importance of healthy food through the curriculum was the only component of a food policy adhered to by as many as 50% of the schools may imply that the concept of a policy guiding food and eating in school was a relatively novel concept in the countries participating in the Pro Children Project in 2003.

Health indicators in children

After controlling for country, neither the existence of a policy at school nor following any of the studied healthful food practices were related to having a high proportion of frequent fruit or vegetable consumers at school or a low proportion of overweight children. The only significant factor associated with the proportion of overweight children at school was having a high proportion of children from low-income families. The significant associations identified before the models were controlled for country (in the case of fruit intake) and SSES (in the case of overweight) are most likely due to conditions within some of the countries, however some alternative explanations may be proposed.

The higher odds for having a high proportion of daily fruit consumers in schools that restricted the use of unhealthy foods in fundraising is plausible given the hypothesized link between healthful practices and positive health indicators in children. However, it is somewhat inconsistent with the inverse relationship found between headmaster awareness and restriction of this practice, along with the proposed interpretation that unhealthy food in fundraising may be seen as an acceptable exception in schools that otherwise follow rather healthful practices. The lower odds of having a high proportion daily fruit consumers if there were restrictions on the sale of unhealthy food at school is likely explained by the fact that Portugal and Austria were the only countries with either no schools or only 10% of schools, respectively, having restrictions on the sale of unhealthy foods in school while at the same time having the highest proportion of daily fruit consumers.

The finding that schools with restrictions on soft drink vending machines had lower odds of having a high proportion of overweight, before controlling for SSES, would be in line with this study's hypothesis and previous findings (Fox *et al*. 2009). However, in this study more than 90% of schools in all but two countries had restrictions on soft drink vending machines. This finding is therefore most likely explained by the fact that Portugal and Austria were the only countries that had a low proportion of schools restricting soft drink vending machines yet they had higher than average proportions of overweight children.

The finding that schools with the most socio-economically disadvantaged children were more than three times as likely to be among the schools with the highest proportions of overweight children (after controlling for country) is in line with previous research (Vereecken *et al*. 2005, WHO 2008a) and indicates that differential health outcomes to a large extent is driven by social determinants. This implies that an important consideration in attempts to identify effective school food policies and healthful practices is that they are effective for improving the health behaviour of the socio-economically disadvantaged children. It should be noted that while this relationship was significant after controlling for country, the strength of the

relationship may have been exacerbated by the fact that Portugal and Spain were the countries with the highest proportions overweight children and also had the highest proportions of socio-economically disadvantaged children.

A few cross-sectional studies have found associations between these health indicators in children and school factors (Kubik, Lytle & Story 2005a, Briefel *et al*. 2009, Fox *et al*. 2009), but most studies are confined to the US where the situation might be rather different from Europe. For example, Kubik, Lytle & Story (2005a) found significant associations between certain "unhealthy" food practices at school (a scale of 7 items) and higher BMI in 14-year old schoolchildren. However, the frequencies of those practices were considerably higher than reported in the Pro Children study. For example, 69% of the schools in their sample used food coupons as reward and over 50% had classroom fundraising that included food sales. As suggested by Lissau (2006), comparisons between the US and Europe may be difficult both because of the higher overweight rates in the US and different practices such as the almost universal presence of vending machines and involvement of commercial operators (Kubik, Lytle & Story 2005b).

Strengths and weaknesses

The strengths of this study include its large international sample with nationally representative data for nine countries gathered at both individual and school level and a high participation rate for both for the child, parent and headmaster surveys. Whereas the data derive from 2003, all questionnaires were filled in within a short time span (3 months), using standardized questionnaires across the nine countries. The study offers new insight into similarities and differences between and within the nine European countries in terms of headmaster awareness, policies and practices, and the associations between these factors, all of which have been sparsely studied in Europe.

The most important limitation of this study is the cross-sectional design which impedes the possibility of explaining how factors at school level may influence each other and also how they may influence health-related indicators in children.

The lack of a definition of “policy” in the questionnaire seems to have caused some difficulty in interpreting the question about school level policy. Furthermore, in the headmaster survey, teaching the importance of healthy food in the curricula was included as a component of a policy, yet it may be questioned whether this component, being the most frequently reported policy component in this study, should be seen as a component of a school level policy. Another limitation of this study is the self-reported nature of the school level data by headmasters who are reporting on classroom food practices. Questionnaires given also to teachers would have strengthened the study by providing a validity test of the consistency in answers given by a headmaster vis-à-vis teachers at the same school.

Another limitation in this study was the limited amount of data on height and weight provided by parents. Since only 45% of the total number of children who participated in the cross-sectional study could be included in this study, the analyses with proportion overweight were severely compromised.

Lastly, the statistical approach taken in this study was not ideal. Since both individual and school level data were available for nine countries, a more sophisticated statistical approach which could take account of variance in the data at all three levels could have offered better insight into the studied associations.

Implications for research and practice

This study suggests that the concept of a school food policy and definitions of what constitute a national or regional policy need to be clarified, so that we know what we measure when school staff are asked about these items. Should for example voluntary guidelines at national or regional level be interpreted as policy, or should they have to be enforceable before being called a policy? At school level, should a "policy" have to

be a formal written code, or could it, as in this study, include elements of the curriculum?

There is also a great need to identify which components of a school food policy that have the highest potential to affect dietary behaviour or weight (Briefel *et al*. 2009, Fox *et al*. 2009, Jaime & Lock 2009). This study did not contribute to a better understanding of this, but as Lytle (2009) has pointed out, in order to identify the most influential factors, this research field must move beyond cross-sectional study design. Furthermore, studies to date rarely address validity of environmental instruments and research in this area is highly needed if we want to be able to study relationships between environmental measures and other factors and understand how social and individual factors interrelate with the physical environment.

This research field would benefit from a discussion and agreement on the categorization of "policies" versus "practices" within the wider context of school food environments. In the recent systematic review on effectiveness of school food and nutrition policies by Jaime & Lock (2009), the Pro Children study itself qualified for inclusion because health behaviour intervention studies were included in the review. It may be argued that effects of time-limited health behaviour interventions offered to schools by research teams are quite different from effects of policy initiatives taken at school level. The latter may better reflect a concerted school effort at following healthful food practices and thus better mirror prevailing norms around eating in school which would increase the likelihood of obtaining sustainable effects.

Concluding remarks

This study found that headmaster awareness of national or regional policies related to food in schools increases the likelihood that the school has its own policy and that certain healthful practices are followed. It may therefore be concluded that policies at national or regional level are likely to have an influence on school level policies and practices. The wide variation in headmaster awareness of national or regional policies within countries suggests that policies or discussions about the subject could have

been better communicated from state or federal level to school level in the countries taking part in the Pro Children Project in 2003.

This study did not find any significant associations between school level policy or practices and health outcomes in children. Whereas further research on possible links is warranted and especially on how social and individual factors interrelate with the physical environment, this study suggests that schools are only one among many sectors and settings to work with in order to create healthy food environments that stimulate a sufficient fruit and vegetable intake and healthy weight development in children. Future research on effectiveness of school food policies should pay due attention to socio-economically disadvantaged children to ensure that they in particular benefit from school-based policies.

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Figure 1 Attributes of school food policies and practices and studied associations

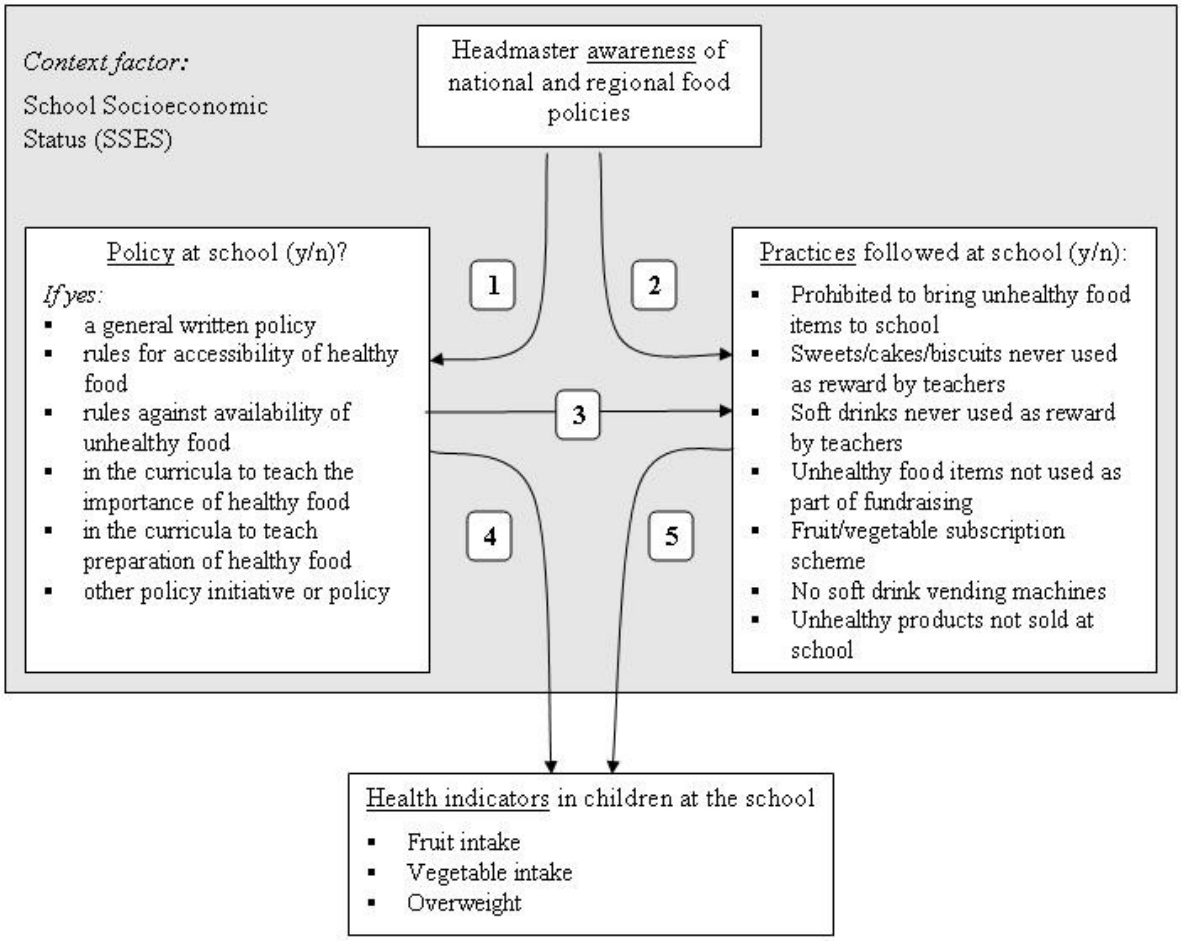

Table 1 Percentage of schools that had a school food policy and their specific content[a] in nine European countries: The Pro Children study

Country[b]	NO	ES	IS	DK	PT	AT	NL	SE	BE	Aver-age
Had policy at school	58	78	90	44	90	58	43	38	84	61
If yes, specific content:										
General written policy	8 (14)[c]	34 (44)	42 (46)	19 (44)	5 (6)	21 (36)	2 (5)	14 (38)	18 (21)	17 (28)
Rules for accessibility of healthy food	6 (10)	44 (56)	26 (29)	18 (40)	53 (59)	42 (73)	9 (21)	29 (75)	49 (58)	27 (44)
Rules against availability of unhealthy food	44 (76)	44 (56)	68 (75)	28 (60)	47 (53)	42 (73)	9 (21)	21 (56)	51 (61)	37 (60)
Curricula: Teach importance of healthy food	54 (93)	63 (80)	65 (71)	28 (60)	58 (65)	47 (82)	39 (90)	31 (81)	80 (95)	50 (81)
Curricula: Teach to prepare healthy food	50 (86)	22 (28)	81 (89)	21 (44)	11 (12)	26 (46)	7 (16)	24 (63)	33 (40)	31 (50)
Other policy initiative or policy	14 (24)	16 (20)	13 (14)	5 (12)	32 (35)	21 (36)	21 (47)	19 (50)	40 (47)	19 (31)
Schools (n)	50	32	31	57	19	19	44	42	45	339

[a] The content of the policy could only be specified if the headmaster first had said there was a policy in place at school. Schools could report various components of specific content.

[b] NO=Norway, ES=Spain, IS=Iceland, DK=Denmark, PT=Portugal, AT=Austria, NL=Netherlands, SE=Sweden, BE=Belgium (Flanders)

c Numbers in parenthesis show the percentage of schools with specific content when only schools that reported to have a policy (*Had policy at school*) are included.

Table 2 Percentage of schools following selected school food practices, by county[a]: The Pro Children study (n = 352, country n varies between the questions)

Country	NO	ES	IS	DK	PT	AT	NL	SE	BE	Average
Prohibited to bring unhealthy food items to school	29	18	50	5	0	0	8	41	11	19
Sweets/cakes/ biscuits never used as reward at school	45	56	75	41	63	45	53	55	62	54
Soft drinks never used as reward at school	75	84	84	41	100	90	71	91	89	76
Unhealthy food items are not used as part of fundraising	65	91	59	85	37	75	96	80	51	74
Fruit/vegetable subscription scheme at school	26	7	19	14	37	50	0	77	27	26
No soft drink vending machines at school	100	91	100	97	63	25	100	100	91	91
Unhealthy products cannot be purchased at school	83	81	100	71	0	10	100	86	56	73

[a] NO=Norway, ES=Spain, IS=Iceland, DK=Denmark, PT=Portugal, AT=Austria, NL=Netherlands, SE=Sweden, BE=Belgium (Flanders)

Table 3 Proportion of students in each country[a] who daily consume portion of fruit, one portion of vegetables and who are overweight[b]: The Pro Children study

	Proportion daily fruit consumers			***Proportion daily vegetable consumers***			***Proportion overweight***		
	%	(95% CI)	n	%	(95% CI)	n	%	(95% CI)	n
NO	32.7	(27.8, 37.6)	1,149	48.6	(44.1, 53.2)	1,120	15.2	(11.3, 19.0)	638
ES	42.5	(36.9, 48.1)	1,163	40.6	(35.9, 45.3)	1,135	21.1	(17.0, 25.2)	586
IS	35.6	(32.1, 39.1)	1,113	41.5	(35.7, 47.3)	1,102	16.5	(12.4, 20.5)	667
DK	44.2	(41.2, 47.3)	1,875	56.2	(53.0, 59.5)	1,829	12.8	(9.7, 15.9)	911
PT	57.6	(53.0, 62.1)	1,576	59.8	(55.8, 63.9)	1,553	24.3	(21.2, 27.4)	744
AT	48.3	(44.0, 52.6)	1,568	47.1	(43.2, 50.9)	1,552	17.3	(14.4, 20.1)	1088
NL	43.0	(38.5, 47.2)	1,095	65.6	(62.0, 69.3)	1,087	9.5	(6.2, 12.8)	616
SE	36.4	(32.4, 40.5)	1,323	53.0	(48.3, 57.8)	1,300	12.6	(9.2, 16.1)	826
BE	36.7	(32.6, 40.9)	1,238	62.7	(57.9, 67.5)	1,213	12.1	(8.3, 15.9)	897
Average % and Total n	40.6	(39.1, 42.2)	12,100	53.9	(52.2, 55.6)	11,891	14.5	(13.2, 15.8)	6,973

[a] NO=Norway, ES=Spain, IS=Iceland, DK=Denmark, PT=Portugal, AT=Austria, NL=Netherlands, SE=Sweden, BE=Belgium (Flanders).

[b] including obese, as defined by IOTF (Cole *et al*. 2000)

Table 4: Logistic regression analysis of schools having a high proportion of students who daily eat at least one portion of fruit or are overweight: The Pro Children study

Outcome	***Predictors***	***Model 1***[1]		***Model 2***[2]		***Model 3***[3]	
	Restrictions on:	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Prop daily **fruit** consumers (hi vs. two low tertiles)	use of unhealthy foods in fundraising	2.10*	(1.14, 3.85)	2.10*	(1.10, 4.0)	1.81	(0.81, 4.05)
	sale of unhealthy food	0.27**	(0.16, 0.48)	0.29**	(0.26, 0.95)	0.73	(0.33, 1.59)
	SSES (hi vs low tertile)			1.51	(0.79, 2.90)	0.85	(0.39, 1.85)
Prop **overweight** (hi vs. two low tertiles)	soft drink vending machines	0.45*	(0.20, 0.99)	0.47	(0.20, 1.12)	0.99	(0.29, 3.42)
	SSES (hi vs low tertile)			3.02**	(1.47, 6.21)	3.33*	(1.34, 8.30)

[1] Model 1 shows the variable(s) significant at $P < 0.05$ after a stepwise elimination of other possible predictor variables (crude ORs for fruit not shown)

[2] Model 2 adds school socioeconomic status (SSES) to the model

[3] Model 3 shows ORs when associations shown in Model 2 have been adjusted for country

* significant at $p<0.05$, ** significant at $p<0.005$

Abbreviations: OR=Odds Ratio, Prop=proportion, hi=high, low=lowest, vs.=versus, SSES=school socioeconomic status

Appendix 2 – Staff Questionnaire

Eating habits of School Children

Questionnaire for Headmasters

1. **Please write the name of the school, where the survey takes place:**

_____

2. **What position do you have at this school?**
- ☐ I'm the headmaster
- ☐ I'm the vice headmaster
- ☐ Other school staff, please write your position:

_____

Questions about lunch breaks

3. **On a daily basis how much time is set aside to eat lunch for 11- year old children/grade at this school?**

	Minutes according to time-table	Actual minutes
Less than 10 minutes	☐	☐
10-14 minutes	☐	☐
15-19 minutes	☐	☐
20-24 minutes	☐	☐
25-29 minutes	☐	☐
30 minutes or more	☐	☐

4. **Where do most of the 11-year-old children usually eat their lunch?**
- ☐ in the class room
- ☐ in a special eating area (i.e. in the cantina or elsewhere)
- ☐ at home (in countries where relevant)
- ☐ some other place, please specify:

_____

5. **Are adults present, during the 11-year-old children's lunch breaks?**
- ☐ yes, always
- ☐ yes, most times
- ☐ sometimes
- ☐ seldom
- ☐ never

6. **Do the 11-year-old children have access to refrigerators to store their food and drinks at this school?**

	Yes	No
For food	☐	☐
For drinks	☐	☐

Questions about food availability at the school

7. **Is there a school shop and/or a cantina at this school?**
- ☐ yes, for all children
- ☐ yes, for some children including 11-year-olds
- ☐ yes, for some children but not for 11-year-olds
- ☐ no

8. **Do you have wending machines for children to use at this school?**
(tick more boxes, if relevant)

- ☐ Yes, for fruit
- ☐ Yes, for sweets
- ☐ Yes, for soft drinks
- ☐ Yes, for other food
- ☐ Yes for other drinks
- ☐ No

---

9. **Are the following subscription programs available for 11-year-olds at your school?**
(tick one box in every line)

	No	Yes, all parents who want it need to pay for it	Yes, wealthier parents pay but free for low income children	Yes, without charge for all children
Meal for lunch	☐	☐	☐	☐
Fruit/vegetables	☐	☐	☐	☐
Milk	☐	☐	☐	☐
Other food	☐	☐	☐	☐

10. **Is it possible for the children to buy the following at this school?**
(please tick one box in every line)

	yes, every day	yes, most days	Some days	Never
Fruit	☐	☐	☐	☐
Vegetables	☐	☐	☐	☐
Soup	☐	☐	☐	☐
Fruit juice	☐	☐	☐	☐
Bread or sandwiches	☐	☐	☐	☐
Cakes or sweet biscuits	☐	☐	☐	☐
Milk	☐	☐	☐	☐
Soft drinks (coke, sprite etc.)	☐	☐	☐	☐
Sweets	☐	☐	☐	☐
Hot meals	☐	☐	☐	☐

---

11. Are pupils (any age group) involved in running the school cantina/ shop?

- ☐ Yes
- ☐ No
- ☐ There is no shop or cantina at this school

IF YES:
In which functions are the pupils involved?
(Please tick a box in every line)

	Yes	No
Superior responsibility (managing)	☐	☐
Assortment choice	☐	☐
Purchase	☐	☐
Preparation	☐	☐
Sale	☐	☐

Questions about shopping in the area around the school

12. Are there shops in the area surrounding the school (walking distance), where the children can buy sweets and soft drinks?

- ☐ yes, several
- ☐ yes, one
- ☐ no

13. Are there shops in the area surrounding the school (walking distance), where the children can buy fruit and vegetables?

- ☐ yes, several
- ☐ yes, one
- ☐ no

14. Are the children allowed to leave school during the breaks?

- ☐ yes, all children
- ☐ yes, some children including 11-year-olds
- ☐ yes, some children but not 11-year-olds
- ☐ no

Questions on food policies

15. Is there a national diet/food/nutritional policy for schoolchildren?

- ☐ I do not know
- ☐ No, there is no national policy
- ☐ Yes, but I am not familiar with it
- ☐ Yes, and I am familiar with it

16. Does the municipality have a diet/food/nutritional policy for schoolchildren?

- ☐ I do not know
- ☐ No, there is no regional policy
- ☐ Yes, but I am not familiar with it
- ☐ Yes, and I am familiar with it

17. Does this school have a diet/ food/nutritional policy for the pupils?

- ☐ Yes
- ☐ No

IF you have a school policy:
What does this policy imply?
(please tick more boxes, if relevant)

- ☐ a general written policy paper
- ☐ rules for accessibility of healthy food at the school (e.g. fruit and vegetables)
- ☐ rules against availability of unhealthy food items at school (e.g. sweets and soft drinks)
- ☐ time in the curricula to teach about importance of healthy food habits
- ☐ time in the curricula to teach the children how to prepare healthy food
- ☐ other policy initiatives or activities, please specify:

_____

18. For how long has the school had this policy?
- ☐ Less than a year
- ☐ 1-2 years
- ☐ 3-4 years
- ☐ 5 years or more
- ☐ there is no policy

19. If any, what food and/or beverage items are pupils <u>not</u> allowed to bring to school?
- ☐ Cakes/biscuits
- ☐ Sweets
- ☐ Chocolate/chocolate bars
- ☐ Soft drinks
- ☐ Other: _____

20. Within the last couple of years: Has the school discussed diet/ food/nutritional policy for this school...

	Yes to a great extent	Yes to some extent	No
...at staff meetings	☐	☐	☐
...at parents' meetings	☐	☐	☐
...with the students	☐	☐	☐
...with the school board/ parents council/ *(other relevant policy level)*	☐	☐	☐

Questions about incentives/rewards and fundraising

21. How often do teachers at your school use <u>sweets/cakes/biscuits</u> as a reward?
- ☐ Never
- ☐ On some occasions
- ☐ Often

22. How often do teachers at your school use <u>soft drinks</u> as a reward?
- ☐ Never
- ☐ At some occasions
- ☐ Often

23. Are the pupils allowed to eat or drink during lessons?
- ☐ Never
- ☐ On some occasions
- ☐ Often

24. What can be sold at this school as part of school fundraising?
- ☐ Cakes/biscuits
- ☐ Sweets
- ☐ Chocolate/chocolate bars
- ☐ Chips
- ☐ Soft drinks
- ☐ Fruit

25. Are you part of the health promoting schools' network?
- ☐ Yes
- ☐ no

Questions about demographic characteristics

26. Approximately how many of the students in the school come from (live in) families with few economic resources (low income families, families who receive transfer income)?
- ☐ Less than 5% of the students
- ☐ 5-9% of the students
- ☐ 10-19% of the students
- ☐ 20-29% of the students
- ☐ 30-39% of the students
- ☐ 40-49% of the students
- ☐ 50-74% of the students
- ☐ More than 75% of the students

27. Approximately how many of the students in the school come from ethnic minorities?
- ☐ Less than 5% of the students
- ☐ 5-9% of the students
- ☐ 10-19% of the students
- ☐ 20-29% of the students
- ☐ 30-39% of the students
- ☐ 40-49% of the students
- ☐ 50-74% of the students
- ☐ More than 75% of the students

Thank you very much for your help!